※ 注意：請於試卷內之「非選擇題作答區」標明題號依序作答。

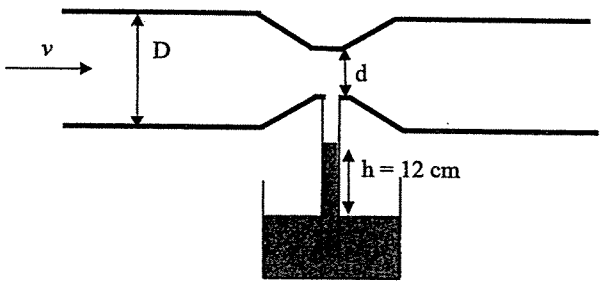
1. A Newtonian fluid is initially at rest between two horizontal plates with vertical separation distance Y (y-direction). At time t = 0, the lower plate is set in motion with horizontal (x-direction) velocity V.
   (a) Find the final velocity ($v_x(y)$) distribution in steady flow.
   (b) Compute the steady-state momentum flux τ_{yx} in lb_f/ft^2 when V = 1 ft/s in the positive x direction. The plate separation Y is 0.001 ft, and the fluid viscosity μ is 0.7 cp.
   (c) Explain the meanings of y and x in τ_{yx} by indicating the plan acted by τ_{yx} and direction of τ_{yx}.
   (10 points)

2. Two adjacent immiscible Newtonian fluids I and II of density ρ_I and ρ_{II} and viscosity μ_I and μ_{II} flow horizontally (z-direction) in two horizontal plates with vertical (x-direction) half height of b. The fluid flow rates are adjusted so that the slit is half filled with fluid I (the more dense phase) and half filled with fluid II (the less dense phase). At upstream position z = 0 and downstream position z = L, the static pressures are p_0 and p_L, respectively.
   (a) Find the relation of $d\tau_{xz}/dx$ vs. Δp.
   (b) Find the relation for p_L, p_0 and Δp.
   (c) Obtain the stress distribution of τ_{xz} at various x.
   (d) Obtain the velocity distribution of u_{Iz} and u_{IIz} at various x.
   (e) Compute the average velocities of u_{Iz} and u_{IIz}, respectively.
   (25 points)

3. A Newtonian fluid flows horizontally (x-direction) through a plate forming a vertical (y-direction) boundary layer with thickness δ varied with flow direction x. The free-stream velocity (that is approaching or entering velocity) is u_∞. The velocity u in boundary varies with y.
   (a) Assume the distribution of u is in parabolic form containing first and third orders of y. Write or propose a distribution equation of u.
   (b) Specify the boundary conditions at y = 0 and δ for solving u.
   (c) Solve for u.
   (15 points)

4. Explain the following terms:
   (a) Reynold number (5 points)
   (b) Froude number (5 points)
   (c) Hydraulic jump (5 points)

5. Air flows steadily through a venture meter, which has a pipe diameter (D) of 0.25 m and a throat diameter (d) of 0.15 m. The flow is incompressible and frictional effects are negligible. If the water tank is open to ambient atmospheric pressure, determine the flow speed (v) at the inlet required to raise the water column of 12 cm.
   (10 points)



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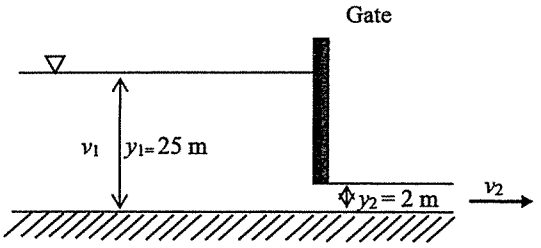
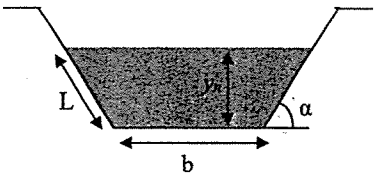
6. Water flows from a big reservoir through a gate into a horizontal, rectangular channel. The flow is frictionless and steady uniform. The water depth of the upstream and the downstream of the gate is 25 m and 2 m, respectively.
   (a) Determine the flow speed downstream of the gate. (8 points)
   (b) Determine the magnitude of the force per unit width exerted in the gate by the flow. (7 points)



7. For a cross section of trapezoidal channel, find the optimum ratio of channel side length to bottom width (L/b) and the optimum side slop angle (α). (10 points)



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